

Deecke (Thes.)

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UREA AND PHOSPHORIC ACID IN  
THE URINE IN ANÆMIA.

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By THEODORE DEECKE. ✓

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The amount of urea excreted by the kidneys stands, as careful observations have shown, in a certain relation to the quality and the quantity of food consumed. Its elimination is also influenced, to some degree, by the occupation or the physical and mental exertion of the individual. It varies greatly from the normal average in diseased conditions of the organism, especially where there is a rapid disintegration of the tissues of the body and of the constituents of the blood.

In the healthy adult the amount of nitrogen contained in the urea excreted, can be considered as almost exactly equal to that contained in the nourishing material absorbed by the system. The amount of urea eliminated is, therefore, a most valuable indicator of the general change of matter in the nitrogenous constituents of the organism.

Another important factor in the composition of the urine is the amount of phosphorus which it contains, in the form of alkaline and earthy phosphates. Regarding the alkaline phosphates, it has become apparent that there exists a special relation between the quantity of these in the urine, and the amount of change of matter in the nervous tissue, which is distinguished by the large proportion of phosphorus contained in easily decomposable compounds. The amount of earthy phosphates is of interest, in its relation to certain pathological processes. These are the calcareous infiltration, or the calcification of physiological and patho-



logical tissues; the depositions of earthy phosphates in cystic cavities, of morbid origin, in various organs of the body; the formation of concretions in the urinary passages and of crystalline deposits in the urine, the latter especially in chronic affections of the bladder.

The history of the formation of urea in the organism, and the seat of its development, can not yet be given in detail. From a chemical point of view the possibility must be admitted, that it has more than one source of derivation. The fact that it is a constant constituent of the blood, that it is found in the chyle, in the serous fluids, in the saliva, and also in various organs and tissues, renders it more than probable that it is not the product of one special organ of the body. It must rather be considered, like its allies, especially the uric acid and the kreatinin, as the general result of the dissociation of certain groups of living albuminous compounds. We add to this that urea possesses the power of dialyzing through animal membranes with great facility, that it acts, when introduced into the system, as a powerful diuretic, and that it is rapidly re-excreted by the kidneys, especially when injected into the blood. From all this it would appear that it is not so much the physiological function of the renal epithelium to produce, but merely to eliminate, or to withdraw this substance from the blood.

The small amount of urea uniformly present in the blood—from two to four parts in ten thousand—and the larger proportion in the arterial, than in the venous blood of the kidneys, offers no argument against this theory, as it has been shown by calculation that it is possible for the whole amount of urea, excreted in a given time, to have been separated from the blood passed during the same time through the kidneys. Moreover, it has been proven by experiment that the

urine is secreted continuously, and that its flow never ceases in health for any length of time. Another argument may be found in the fact that the amount of urea is, in general, independent of the quantity of urine excreted.

The amount of urea eliminated by an average man, in twenty-four hours, is, according to Dr. E. Smith, 33.63 grammes, the daily average in the course of a year; after Parkes, 33.18 grammes; after my own observations, 31.95 grammes in one case, and 34.59 grammes in another case, which gives an average of 33.27. The average amount of phosphoric acid excreted during the same period was, after Parkes, 3.164 grammes; after my own observations, 3.62 in the one, and 2.77 grammes in the other case, an average of 3.195. The variations in the daily amount of urea, in Dr. Smith's case, was from 14.2 grammes to 45.3 grammes; of phosphoric acid, after Parkes, from 2 to 4.3 grammes. According to my analyses, comprising the time of ten days, the variations in the daily quantity of urea amounted to from 27.34 grammes to 41.74 grammes; of phosphoric acid, from 2.17 to 4.21 grammes in the first case; in the second one, of urea, from 24.07 to 39.35 grammes; of phosphoric acid, from 2.59 to 4.16 grammes. The whole quantity of urine, in the last two cases, was 14830 c. c., by daily variations from 1155 c. c. to 1715 c. c. in the first case, and 21144 c. c., by daily variations from 1600 c. c. to 2790 c. c. in the second case. The specific gravity in the first case varied from 1014 to 1026, making an average of 1020-21; in the second one, from 1009 to 1026, an average of 1018-19.

As it will be observed in the foregoing, the figures present a remarkable congruity. A greater number from other authors could be added, in order to substantiate

their correctness. In a healthy average man the daily amount of urea excreted, in grammes, rarely exceeds forty, or is below twenty, while the quantity of phosphoric acid excreted varies between 2 and 4.5 grammes.

It has already been indicated that in morbid conditions of the organism great variations occur. Thus, in the early stages of acute diseases, as pneumonia, typhus, meningitis, the daily amount of urea excreted increases, according to Vogel and Warnecke, to more than twice the normal average—that is, to from seventy to eighty grammes per diem, while in cases of chronic anaemia, according to my own observations, it remains below one-half of the usual average. In all these analyses the determination of the substances excreted was confined to their whole amount, during the twenty-four hours of the day. There is, at present, nothing definite known of their relative quantity at different times during this period, which would appear to be of especial interest in regard to the change of matter during the state of being awake and during sleep. If it is a natural law that the amount of urea excreted, stands in a direct proportion to the amount of physical and mental exertion performed, and that it is to be considered as a measure of muscular and nervous energy, this of course must become noticeable as a constant and regular rise and fall of its amount during the twenty-four hours of the day. I present, in the following tables, the results derived from my own investigations:

TABLE I.—MAN IN HEALTH.

FROM 6 A. M. TO 6 P. M.

FROM 6 P. M. TO 6 A. M.

GRAMMES.										GRAMMES.					
Color; Deposit, etc.	Spec. Gray-ity.	Re-action.	Quan-tity in C. C.	Urea.	Phosphate in Phos.	Phosphate in Air.	Acid in Phos.	Acid in Air.	Phosphate in Ph.	Acid in Phos.	Acid in Air.	Phosphate in Ph.	Acid in Phos.	Acid in Air.	Phosphate in Ph.
Yellow; Clear.	1024	Acid.	760	15.30	1.28	0.34	Light Yellow; Clear.	1020	Acid.	1150	15.84	1.50	0.31		
Yellow; Clear.	1026	Acid.	650	12.00	1.38	0.29	Yellow; Clear.	1018	Acid.	950	11.98	1.31	0.30		
Yellow; Clear.	1011	Acid.	1215	17.60	1.76	0.31	Light Yellow; Clear.	1009	Acid.	1575	13.23	1.30	0.31		
Yellow; Clear.	1021	Acid.	800	14.96	1.27	0.32	Light Yellow; Clear.	1011	Acid.	1230	18.41	1.77	0.32		
Yellow; Clear.	1022	Acid.	915	18.21	1.40	0.34	Yellow; Clear.	1023	Acid.	880	17.75	1.69	0.30		
Yellow; Clear.	1015	Acid.	1314	16.56	1.73	0.30	Yellow; Clear.	1018	Acid.	1190	14.23	0.90	0.31		
Yellow; Clear.	1019	Acid.	825	13.94	1.54	0.32	Yellow; Clear.	1018	Acid.	1020	12.37	1.15	0.30		
Yellow; Clear.	1020	Acid.	930	17.43	1.31	0.28	Yellow; Clear.	1022	Acid.	975	13.91	1.42	0.31		
Yellow; Clear.	1016	Acid.	1190	18.12	1.86	0.31	Yellow; Clear.	1021	Acid.	1350	21.23	1.67	0.32		
Yellow; Clear.	1018	Acid.	1075	15.30	1.46	0.33	Yellow; Clear.	1023	Acid.	1010	21.01	2.08	0.33		
TOTAL,	10182		9654	160.57	14.59	3.14		10182		11480	150.96	14.88	3.11		

TABLE II.—WOMAN IN HEALTH.  
FROM 6 A. M. TO 6 P. M.

Color; Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in Urea. C. C.	GRAMMES.				GRAMMES.					
				Phos- phate in Alk. Acid.	Phos- phate in Earthy Ph. Acid.	Color; Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in Urea. C. C.	Phos- phate in Alk. Acid.	Phos- phate in Earthy Ph. Acid.		
Light Yellow; a little Cloudy from Urate of Soda.	1014	Acid.	900	9.30	0.90	0.31	Yellow; Clear.	1025	Acid.	555	18.04	1.17	0.33
Yellow; Clear.	1020	Acid.	900	18.81	1.49	0.32	Yellow; Clear.	1019	Acid.	515	10.36	0.76	0.32
Yellow; Clear.	1026	Acid.	635	15.03	1.24	0.33	Yellow; Clear.	1023	Acid.	850	20.02	1.19	0.34
Yellow; Clear.	1021	Acid.	620	17.83	0.97	0.33	Yellow; Clear.	1018	Acid.	945	20.43	1.70	0.34
Yellow; Clear.	1015	Acid.	660	11.45	0.81	0.32	Yellow; Clear.	1021	Acid.	650	16.94	0.71	0.31
Yellow; Clear.	1024	Acid.	900	25.31	1.62	0.33	Yellow; Clear.	1019	Acid.	815	16.43	1.83	0.33
Yellow; Clear.	1021	Acid.	950	19.29	0.75	0.31	Yellow; Clear.	1018	Acid.	530	13.68	0.80	0.32
Yellow; Clear.	1023	Acid.	750	18.91	1.16	0.33	Yellow; Clear.	1022	Acid.	630	17.19	0.73	0.31
Yellow; Clear.	1022	Acid.	800	20.00	0.80	0.33	Yellow; Clear.	1019	Acid.	940	19.34	0.78	0.31
Yellow; Clear.	1020	Acid.	890	18.11	0.80	0.33	Yellow; Clear.	1021	Acid.	635	18.35	0.78	0.33
<b>TOTAL,</b>	10206		7705	173.03	10.82	3.24	<b>TOTAL,</b>	10204		7125	172.89	10.45	3.24

TABLE III.—WOMAN (L. L. S.)

FROM 6 A. M. TO 6 P. M.

FROM 6 P. M. TO 6 A. M.

Color; Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in C. C.	GRAMMES.				GRAMMES.			
				Alka- line.	280	5.29	0.11	0.23	Color; Deposit, etc.	Spec. Grav- ity.	Re- action.
Yellow; Turbid; White Deposit; Urates and Triple Phosphates.	1022	Alka- line.							Yellow; Clear.	1017	Slightly Acid.
Yellow; Cloudy; White Deposit of Urates.	1016	Alka- line.	765	10.17	0.70	0.29			Dark Yellow; Cloudy; Deposit of Urates.	1023	Slightly Acid.
Almost Colorless; 'A Little Cloudy; small Deposit of Urates.	1008	Neutral.	763	6.71	0.16	0.30			Yellow; Clear.	1022	Acid.
Pale Yellow; Cloudy; Deposit of Urates.	1010	Acid.	327	3.59	0.08	0.21			Yellow; a little Cloudy; Deposit of Urates.	1017	Acid.
Pale Yellow; Clear.	1012	Slightly Acid.	515	6.27	0.09	0.21			Yellow; Clear.	1024	Acid.
Pale Yellow; Clear.	1012	Slightly Acid.	515	6.41	0.17	0.23			Light Yellow; Clear.	1018	Acid.
Pale Yellow; Clear.	1008	Neutral.	562	5.50	0.14	0.20			Yellow; Clear.	1014	Acid.
Pale Yellow; a little Cloudy; Deposit of Urates.	1013	Slightly Acid.	515	6.81	0.14	0.20			Yellow; Clear.	1023	Acid.
Pale Yellow; Cloudy; Deposit of Urates.	1007	Neutral.	545	4.81	0.03	0.20			Yellow; Clear.	1020	Acid.
Pale Yellow; Clear.	1008	Neutral.	575	4.64	0.24	0.22			Yellow; Clear.	1019	Acid.
<b>TOTAL,</b>	<b>10116</b>		<b>5262</b>	<b>60.30</b>	<b>1.86</b>	<b>2.38</b>			<b>TOTAL,</b>	<b>10197</b>	
										<b>4129</b>	<b>61.23</b>
										<b>8.06</b>	<b>3.86</b>

TABLE IV.—MAN (J. T.)

FROM 6 A. M. TO 6 P. M.

Color; Deposit, etc.	Spec. Gray- ity.	Re- action.	Quan- tity in Urea, C. C.	GRAMMES.				GRAMMES.					
				Phosphate in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.	Phosphate in Acid in Alk. Phos.		
Dark Yellow; Clear.	1033	Acid.	290	6.53	0.59	0.30	Dark Yellow; Clear.	1035	Acid.	304	10.89	0.83	0.39
Dark Yellow; Clear.	1025	Acid.	235	6.75	0.54	0.26	Yellow; Turbid; White Deposit of Urates and Phosphates.	1030	Slightly Alka- line.	280	6.64	0.65	0.30
Dark Yellow; a Little Cloudy; Deposit of Urates.	1029	Acid.	200	6.03	0.22	0.26	Dark Yellow; Turbid; White Deposit of Urates and Phosphates.	1027	Slightly Alka- line.	194	7.06	0.58	0.26
Yellow; Cloudy; White Deposit of Urates and Triple Phosphates.	1025	Slightly Alka- line.	398	5.91	0.24	0.27	Dark Yellow; a little Cloudy; Deposit of Urates.	1030	Acid.	200	6.54	0.57	0.25
Yellow; Cloudy; Deposit of Urates and Phos- phates.	1021	Slightly Alka- line.	398	5.30	0.14	0.26	Pale Yellow; Clear.	1005	Neutral.	865	4.46	0.56	0.24
Yellow; Clear.	1022	Acid.	375	4.84	0.27	0.27	Yellow; Clear.	1009	Acid.	728	5.87	0.42	0.26
Dark Yellow; a Little Cloudy; Deposit of Urates.	1029	Acid.	235	5.91	0.43	0.26	Yellow; a little Cloudy; Deposit of Urates.	1024	Acid.	390	7.00	0.63	0.24
Yellow; Clear.	1023	Acid.	398	8.12	0.33	0.25	Yellow; Clear.	1026	Acid.	325	8.78	0.71	0.23
Yellow; very Little Cloudy; Deposit of Urates and Urates.	1023	Acid.	318	8.01	0.47	0.23	Yellow; Clear.	1023	Acid.	500	10.64	0.74	0.24
Dark Yellow; Clear.	1026	Acid.	288	8.47	0.37	0.29	Yellow; Clear.	1024	Acid.	320	7.70	0.73	0.25
<b>TOTAL,</b>	10256		3078	65.87	3.60	2.63	<b>TOTAL,</b>	10233		4166	75.67	6.42	2.65

TABLE V.—WOMAN (C. S.)

FROM 6 A. M. TO 6 P. M.

FROM 6 P. M. TO 6 A. M.

Color: Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in C. C.	GRAMMES.				GRAMMES.			
				Phosphate in Urea.	Phosphate in Am. Phos.	Color: Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in C. C.	Phosphate in Am. Phos.	Color: Deposit, etc.
Light Yellow; Clear.	1029	Acid.	125	3.98	0.39	0.20	Yellow; Clear.	Acid.	365	10.27	0.80
Yellow; Clear.	1028	Acid.	250	7.73	0.52	0.23	Yellow; Clear.	Acid.	32	9.25	1.65
Yellow; Clear.	1023	Acid.	187	4.27	0.72	0.28	Yellow; Clear.	Acid.	502	8.22	1.53
Light Yellow; Clear.	1021	Acid.	457	9.17	0.60	0.22	Yellow; Clear.	Acid.	281	8.71	0.73
Dark Yellow; Clear.	1025	Acid.	172	4.22	0.08	0.24	Yellow; Clear.	Acid.	349	7.80	0.84
Yellow; Clear.	1023	Acid.	250	5.18	0.12	0.24	Yellow; Clear.	Acid.	365	13.90	1.05
Dark Yellow; Clear.	1034	Acid.	126	4.30	0.12	0.04	Yellow; Clear.	Acid.	311	6.18	0.54
Dark Yellow; Clear.	1031	Acid.	156	4.70	0.10	0.14	Light Yellow; Clear.	Acid.	467	8.78	1.03
Yellow; Clear.	1028	Acid.	203	5.24	0.28	0.20	Yellow; Clear.	Acid.	421	16.54	1.54
Yellow; Clear.	1028	Acid.	188	4.15	0.11	0.08	Yellow; Clear.	Acid.	485	14.20	1.12
<b>TOTAL,</b>	10270		3065	32.34	3.12	2.03	TOTAL.	10258	3768	104.15	10.29
											2.31

TABLE VI.—MAN (C. G.).

FROM 6 P. M. TO 6 A. M.

TABLE VII.—WOMAN (M. M.)

FROM 6 A. M. TO 6 P. M.  
FROM 6 P. M. TO 6 A. M.

GRAMMES.										GRAMMES.			
Color; Deposit, etc.	Spec. Gravity.	Re-action.	Quantity in C. C.	Ureat.	Perchloric Acid.	Color; Deposit, etc.	Dark Yellow; a little Urates.	Dark Yellow; a little Urates.	Color; Deposit, etc.	Spec. Gravity.	Re-action.	Quantity in C. C.	
Dark Yellow; Clear.	1020	Acid.	201	5.80	0.24	0.25	The Same.	1026	Acid.	201	12.48	1.25	0.25
Dark Yellow; Cloudy; Deposit of Urates.	1025	Acid.	180	3.91	0.13	0.20	The Same.	1030	Acid.	201	6.45	0.28	0.24
The Same.	1026	Acid.	230	6.25	0.40	0.15	The Same.	1029	Acid.	235	5.90	0.36	0.26
Light Yellow; Deposit of Urates.	1016	Acid.	455	8.24	0.44	0.15	Yellow; Deposit of Urates.	1027	Acid.	230	6.85	0.44	0.25
Yellow; Deposit of Urates.	1020	Acid.	500	10.06	1.11	0.13	Yellow; Cloudy; Deposit of Urates.	1020	Acid.	453	6.35	0.30	0.21
Pale Yellow; Clear.	1003	Acid.	312	3.36	0.01	0.13	The Same.	1014	Acid.	155	8.54	0.21	0.22
Light Yellow; a little Cloudy; Deposit of Urates.	1018	Acid.	515	6.50	0.41	0.15	Dark Yellow; Deposit of Urates.	1021	Acid.	300	4.18	0.26	0.23
Yellow; Deposit of Urates.	1014	Acid.	640	13.12	1.01	0.20	Yellow; Deposit of Urates.	1025	Acid.	355	7.70	0.25	0.22
Pale Yellow; Clear.	1022	Acid.	560	4.76	0.06	0.11	Pale Yellow; Clear.	1010	Acid.	295	3.92	0.07	0.26
Yellow; Clear.	1008	Acid.	530	5.23	0.49	0.15	Yellow; Clear.	1023	Acid.	290	4.79	0.24	0.28
TOTAL.	10153		4113	67.41	4.26	1.47	TOTAL.	10256		3744	67.40	3.55	2.44

TABLE VIII.—MAN (C. H.)

FROM 6 A. M. TO 8 A. M.  
FROM 6 P. M. TO 8 P. M.

GRAMMES.										GRAMMES.			
Color; Deposit, &c.	Shoe- Grav- ity.	Re- action.	Quan- tity in C. C.	Shoe- Grav- ity.	Re- action.	Quan- tity in C. C.	Shoe- Grav- ity.	Re- action.	Quan- tity in C. C.	Shoe- Grav- ity.	Re- action.		
Yellow; Clear.	1025	Acid.	625	20.85	1.30	0.30	Pale Yellow; Clear.	1020	Slight- ly Acid.	11.19	0.51	0.28	
Yellow; Oily; Deposit of Soda Phosphates.	1017	Acid.	688	16.58	1.06	0.29	Pale Yellow; a little Pos- t of Phosphate of Cal- cium.	1010	Slight- ly Acid.	11.29	0.53	0.36	
Yellow; Turbid; Deposit of Triple Phosphate.	1000	Neutral.	843	10.35	1.32	0.32	Turbid; Deposit of Triple Phosphates.	1024	Alka- line.	16.92	1.22	0.33	
The Same.	1018	Alka- line.	1156	15.15	1.22	0.31	The Same.	1015	Alka- line.	8.13	0.74	0.31	
The Same.	1026	Alka- line.	562	11.48	2.00	0.30	The Same.	1024	Alka- line.	3.55	0.67	0.29	
The Same.	1023	Alka- line.	781	18.66	1.91	0.28	The Same.	1022	Alka- line.	12.50	0.55	0.30	
The Same.	1024	Alka- line.	655	11.21	1.74	0.30	The same.	1024	Alka- line.	9.94	0.55	0.29	
Yellow; a little Oily; Deposit of Urates and Phosphates.	1029	Slight- ly Acid.	406	13.58	0.32	0.28	The same as from 6. A. M. to 6 P. M.	1026	Alka- line.	8.77	0.29	0.26	
The Same.	1024	Slight- ly Acid.	555	9.98	0.51	0.35	The Same.	1022	Slight- ly Acid.	14.11	0.30	0.38	
Pale Yellow; Clear.	1011	Acid.	625	6.88	0.20	0.30	Yellow; Clear.	1021	Acid.	25.55	1.17	0.32	
<b>TOTAL,</b>	10206		6386	16.95	12.18	2.05		1026		6196	126.47	7.44	3.02

TABLE IX.—WOMAN (M. MC.)

FROM 6 A. M. TO 6 P. M.

Color; Deposit, etc.	Spec. Grav- ity.	Re- action.	Quan- tity in C. C.	Urea.	Pleisiothio- ph. Alk. Phos- phate in Hg.	Pleisiothio- ph. Alk. Phos- phate in Hg.	Color; Deposit, etc.	Spec. Grav- ity.	Re- action.	GRAMMES.		Quantity in C. C.	Pleisiothio- ph. Alk. Phos- phate in Hg.	Pleisiothio- ph. Alk. Phos- phate in Hg.	
										GRAMMES.					
Yellow; a little Cloudy; Deposit of Urate of Soda.	1025	Acid.	312	5.15	0.34	0.31	The same as from 6 A. M. to 6 P. M.	1022	Acid.	512	7.26	0.39	0.30		
Dark Yellow; Turbid; Deposit of Urate of Soda.	1028	Acid.	315	15.60	0.75	0.30	Yellow; Clear.	1028	Acid.	470	18.10	1.29	0.31		
Light Yellow; Clear.	1015	Acid.	343	7.31	1.23	0.30	Pale Yellow; Clear.	1010	Acid.	470	6.89	0.51	0.28		
Straw Yellow; Clear.	1020	Acid.	406	9.48	0.60	0.29	Yellow; Clear.	1016	Acid.	500	12.32	0.85	0.29		
Dark Yellow; Clear.	1028	Acid.	281	8.77	0.60	0.30	Yellow; Clear.	1026	Acid.	375	13.85	0.40	0.28		
Yellow; a little Cloudy; Deposit of Urate of Soda.	1028	Acid.	250	7.18	0.44	0.28	Light Yellow; Clear.	1010	Acid.	500	7.55	0.48	0.30		
Yellow; Turbid; Deposit of Urate of Soda.	1030	Acid.	230	8.30	0.63	0.29	Yellow; a little Cloudy; Deposit of Urate of Soda.	1036	Acid.	312	12.14	0.33	0.31		
Yellow; a little Cloudy; Deposit of Urate of Soda.	1032	Acid.	375	10.65	0.71	0.30	The Same.	1020	Acid.	511	16.02	1.76	0.31		
Pale Yellow; Clear.	1009	Acid.	406	4.59	0.02	0.29	Pale Yellow; Clear.	1007	Acid.	500	3.30	0.12	0.29		
Yellow; Clear.	1015	Acid.	500	5.59	0.26	0.28	Yellow; Clear.	1008	Acid.	625	6.05	0.33	0.30		
TOTAL,	10230		3438	82.32	5.58	2.34	TOTAL,	10142		4815	104.48	7.86	2.48		

TABLE X.—MAN (W. M.)  
FROM 6 A. M. TO 6 P. M.

GRAMMES.								GRAMMES.						
Color; Deposit, etc.	Spec. Grav.	Re-action.	Quan-tity in C. C.	Urea.	Urea.	Color; Deposit, etc.	Spec. Grav-ity.	Re-action.	Quan-tity in C. C.	Urea.	Urea.			
Pale Yellow; Clear.	1011	Acid.	1230	17.91	1.05	0.20	Yellow; Clear.	1002	Acid.	1940	17.94	1.27	0.22	
Could not be Obtained.							Pale Yellow; Clear.	1003	Acid.	1780	17.80	1.21	0.21	
Could not be Obtained.	1012	Acid.	812	11.97	0.63	0.22	Pale Yellow; Clear.	1004	Acid.	1575	16.95	1.25	0.23	
Pale Yellow; Clear.	1009	Acid.	1375	22.96	1.04	0.21	Pale Yellow; Clear.	1003	Acid.	1575	15.84	1.27	0.23	
Pale Yellow; Clear.	1009	Acid.	2000	26.00	1.52	0.24	Pale Yellow; Clear.	1008	Acid.	1575	22.38	1.58	0.22	
Could not be Obtained.							Pale Yellow; Clear.	1010	Acid.	1575	22.00	1.52	0.24	
Could not be Obtained.							Pale Yellow; Clear.	1007	Acid.	2375	30.64	2.35	0.25	
Pale Yellow; Clear.	1013	Acid.	1275	20.94	1.28	0.21	Pale Yellow; Clear.	1009	Acid.	1365	19.10	1.34	0.24	
TOTAL IN 5 DAYS.	10054			6712	96.08	5.52	1.08	TOTAL <sub>a</sub>	10048		17326	203.80	15.29	228.

The examinations, as the tables show, have been carried out so that in each case the urine which was passed during the twelve hours of the day was collected, measured and analyzed separately from that passed during the twelve hours of the night. In the first there was, therefore, included the quantity passed immediately after the day's work and exercise; in the latter, the morning urine after night's rest.

The estimations were made by the volumetric method, and in every case an equal volume of the urine was subjected to an analysis, while the same measuring tubes were employed. The relations the figures bear to each other are therefore correct, even if there should be an error in the absolute quantity which they represent. The latter may, however, hardly be expected, since the liquids used were prepared by myself, and their strength, estimated by adding a known quantity of pure urea and of pure phosphate of soda to a certain amount of urine, and by determining the quantity of each present in the urine, before and after the addition. The figures, of course, give the whole amount of the urea and the phosphoric acid excreted.

In the first two tables I present for comparison the results of the examination of the urine of two persons, in health, during the time of ten days. Table I. is that from a man about forty years of age, of regular habits of life, and who had, during the day, a fair amount of physical exercise, while the night hours, from eight to twelve o'clock, were occupied by mental labor; sleep amounted to from five and a half to six hours. The woman was about twenty-five years of age, mother of two children, of which the one was still on the breast. She was doing common housework during the day, and spent some evening hours in reading, etc. She was in the habit of retiring early, between nine and ten o'clock

P. M.; sleep amounted, in the average, to from eight to nine hours.

If we subject the first table to a closer examination, comparing the single data, we find that there is a considerable fluctuation in the whole daily amount of urea excreted from a minimum of 24.07 grammes, during the twenty-four hours of the fourth day, to the maximum of 39.35 grammes on the ninth day, making a difference of 15.28 grammes. The amount of phosphoric acid excreted during the same period varied from 3.28 grammes to 4.20 grammes, making a difference of 0.92 grammes. If we, however, take the arithmetical mean of the whole amount of urea and phosphoric acid, excreted in the ten days, equal to 319.53 grammes of the former, and 36.22 grammes of the latter, we have 31.95 grammes of urea, and 3.62 grammes of phosphoric acid, excreted per diem, figures very closely, reaching the normal average above stated.

If we compare the quantities of urea and phosphoric acid excreted during the hours from 6 A. M. to 6 P. M., with those excreted from 6 P. M. to 6 A. M., we find that the highest difference amounts to 4.46 grammes in the former, and 0.53 grammes in the latter. Yet the most interesting fact is the close correspondence of the total amounts excreted; of urea, 159.57 grammes, from 6 A. M. to 6 P. M., and 159.96 grammes from 6 P. M. to 6 A. M.; of phosphoric acid, 18.23 grammes from 6 A. M. to 6 P. M., and 17.99 grammes from 6 P. M. to 6 A. M. Moreover, the sums of specific gravities, 10182, are exactly the same up to the last figure, while in the total quantity of urine, 9664 c. c. and 11480 c. c., there is a plus of 1876 c. c. on the side of the amount excreted during the night.

If we look over the second table, we will first notice the same correspondence between the total quantities

of urea and phosphoric acid excreted during the hours of the day, and those excreted during the nights, of urea, 173.03 grammes from 6 A. M. to 6 P. M., and 172.89 grammes from 6 P. M. to 6 A. M.; of phosphoric acid, 13.96 grammes from 6 A. M. to 6 P. M., and 13.71 grammes from 6 P. M. to 6 A. M. There is only a slight difference between the sums of the specific gravities, 10206 to 10204, while the total quantities of the urine, 7705 c. c., and 7125 c. c., show a plus of 580 c. c. on the side of the amount excreted during the day. The difference between the minimum, 27.34 grammes, and the maximum, 41.74 grammes, of the total daily excretion of urea, making 14.40 grammes, corresponds with that of the foregoing table, 15.28 grammes; while the sum of the whole amount of the ten days, 345.92 grammes, gives a daily average of 34.59 grammes, against the 31.95 grammes of table I. This slight increase, hardly worthy of notice, is probably due to the differences in the age of the two persons, since the quality of the food partaken, was the same during the time when the examinations were made. The daily fluctuations in the whole amount of phosphoric acid, in table II, are higher than in table I, from 2.17 grammes to 4.11 grammes, yet inside of the limits of the normal average. The total amount, however, of the ten days, 27.67 grammes, against 36.22 grammes in table I, making a difference of 8.55 grammes, or 0.855 per diem, is a fact to which I call attention for the reason that I have made a great number of series of comparative analyses of the urine of healthy men and women, with the same result, viz.: that there was in all cases a considerable falling off in the amount of phosphoric acid in the urine of the latter, due invariably to the presence of a smaller quantity of the alkaline phosphates, while the amount of the

earthy phosphates was generally of a remarkable uniformity.

Regarding finally the proportion of the amount of urea and of phosphoric acid excreted in the urine of healthy persons, it is evident that no certain relation between the two substances exists, since the figures of the table show that, as well in the daily amount of urea and phosphoric acid excreted, as in the total of a series of days the minimum amount of the former may be co-existent with the maximum of the latter, and *vice versa*.

From the facts presented in tables I and II, I draw the following general conclusions regarding the elimination of urea and phosphoric acid in a state of health.

1. The processes of waste and repair in the human system, which are represented quantitatively by the amount of urea and phosphoric acid eliminated through the kidneys are going on continuously and, generally, with a remarkable uniformity.
2. The temporary fluctuations in their energy are balanced by periodic equalizations.
3. The processes are quantitatively the same during the twelve hours of the day as during the twelve hours of the night.
4. The rise and fall in the amount of urea excreted is independent of the physical and mental occupation of the individual.
5. The amount of phosphoric acid in the alkaline phosphates, eliminated by the kidneys, seems to stand in proportion to the change of matter in the nervous tissues of the body.

We will now consider the data presented in tables III to X.

The persons who furnished the urine for the analyses in these tables were in a general anaemic condition com-

ERRATUM—Page 19, second line from the top, for *physical*  
read *psychical*.

bined, with the exception of the case given in table IX, with more or less physical disturbance. Yet differences are to be recorded in each case in regard to the etiology, the course and the prognosis of the affection.

In the two cases represented by tables III and IV, there was a chronic general anæmia of a slow and gradual development. As to the mental state there was a likewise slowly developed sub-acute maniacal condition with a tendency to dementia. In the cases, tables V and VI, the anæmia was of a more acute origin; in the first, of the woman, connected with puerperal mania; in the second, of the man, connected with melancholic excitement, originating from excesses in venere. The case, table VII was one of chronic general anæmia with dementia; the case, table VIII, one of acute anæmia from loss of blood by a suicidal attempt; case, table IX, one of chlorosis; and case, table X, one of secondary anæmia, combined with paresis.

If we compare the tables we will first notice, with the exception of table VIII, acute anæmia, and table X, secondary anæmia with paresis, the remarkable falling off of the amount of urea and phosphoric acid during the ten days of observation. The former reaches its lowest figure in table III, sub-acute mania with a tendency to dementia, 121.43 grammes in ten days; the latter in table VII, dementia, only 11.08 grammes in ten days, making a daily excretion of 12.14 grammes of urea and 1.108 grammes of phosphoric acid, or in each day 21.13 grammes of urea and 1.66 grammes of phosphoric acid less than the normal average. The highest figure for both substances in the chlorotic patient, table IX, is 187.20 grammes of urea, and 19.36 grammes of phosphoric acid, which makes a daily falling off of 14.55 grammes of the former and 0.84 grammes of the latter. In table VI, a case in which the patient, a mel-

ancholic, etc., regained his bodily strength and was discharged mentally improved, we find 243.71 grammes for urea and 19.00 grammes for phosphoric acid, or daily 8.90 grammes of the former and 1.9 grammes of the latter less than the normal average.

In table VIII, the case of acute anaemia, the figures show 273.12 grammes of urea and 25.79 grammes of phosphoric acid, excreted in ten days, or a daily falling off of only 5.96 grammes of the former and of 0.58 grammes of the latter. As the anaemic condition in this case was consecutive upon a considerable loss of blood and not connected with primary general disturbances of nutrition, the comparatively high figures are quite in accordance with experiments made on animals, which have shown that the amount of change of matter in the animal body, is of course in certain limits, independent of the quantity of blood in circulation. In table X, the one half of which is incomplete, but which, when completed in the same rate, as recorded during five days of observation, would give in ten days 402.05 grammes of urea and 31.77 grammes of phosphoric acid, or a daily increase of urea of 6.93 grammes over the normal. This increase unquestionably indicates the wasting of tissues concomitant with the progressive pathological processes characteristic of the disease.

The examination of the tables from the point of view of the relative amount of the substances in question excreted during the twelve hours of the day compared with that excreted during the twelve hours of the night, reveals the following interesting facts: In tables III, IV and VII, we find in regard to the relative quantity of urea during the ten days of observation from 6 A. M. to 6 P. M. and from 6 P. M. to 6 A. M. the same correspondence as in table I and II of the healthy persons, although the whole amount remained much below one

half of the normal. The figures 60.20 grammes and 61.23 grammes of urea in table III, and 67.41 grammes and 67.10 grammes of urea in table VII, correspond exactly. In table IV the 65.87 grammes of urea during the day and the 75.67 grammes during the night give a difference of 9.8 grammes or of 0.98 grammes daily, which can be considered as unimportant.

In regard, however, to the amount of phosphoric acid excreted during the same period we notice a remarkable difference. In table VII, case of dementia, the figures for the phosphoric acid from alkaline phosphates as well as from the earthy phosphates, although more than one-half below the normal, correspond exactly. In table IV, the quantity of the alkaline phosphates excreted during the hours of the night is about twice that excreted during the day; in table III the quantity of the former exceeds about five times that of the latter. In both cases, though far below the normal, this would indicate, as I believe, a favorable increase in the change of matter in the nervous tissues during rest, while in the foregoing case of dementia table VII, that change of matter seemed to have reached both during day and night an exceedingly low point. The theory advanced here, appears to be supported by facts arrived at in table V and VI. There we find a similar relation. The amounts of the earthy phosphates correspond almost exactly. Of the alkaline phosphates we find about three times the quantity excreted during the night as during the day. Yet in the latter two cases, we furthermore notice the interesting fact, that in the first one, table V, the amount of urea excreted during the night also exceeds exactly twice the amount excreted during the day; while in the second case, table VI, the proportion between the two is not very far from being the same, viz: 52.94 grammes of urea during the day, against

104.15 grammes during the night in the first case; and 88.78 grammes of urea during the day against 154.93 grammes during the night in the second case. Both cases were taking physically and mentally a favorable course, and it appears as if nature in both was making an effort to balance the disturbed and impeded change of matter during the day, by an increase of double its amount during rest. This view finds another affirmation in the facts revealed by table IX, the case of the chlorotic patient, where we again observe the similar increase of the amount both of urea and of phosphoric acid excreted during the hours of rest, viz: 82.52 grammes of urea and 5.58 grammes of phosphoric acid from the alkaline phosphates during the day, against 104.68 grammes of urea and 7.86 grammes of phosphoric acid during the night.

In table VIII, the case of acute anaemia, a slight increase in the amount of urea, as well as of phosphoric acid, will be noticed on the side of the excretion during the day, of about 2 grammes of urea and 0.5 grammes of phosphoric acid per diem. This small difference, of course, would seem to be of not much weight, yet, when we look over the single data presented in the table, it becomes apparent that there existed great fluctuations in the amount, both of the urea and the phosphoric acid excreted. With the exception of the last two days, there is a remarkable increase in the change of matter during the day over that during the night. It may be remarked here, therefore, that the patient, during the time when the examinations were made, was exceedingly restless and excited during the night, so that it became finally necessary to administer at midnight a second dose of hydrate of chloral, the effect of which was at once noticed in the change of the excretion of urea, as well as of phosphoric acid, by the remarkable increase in their

quantity during the night, viz: In the last two days, 16.86 grammes of urea and 0.71 of phosphoric acid, from the alkaline phosphates, during the day-time, against 37.66 grammes of urea, and 2.67 grammes of phosphoric acid during the nights. This fact again appears to affirm the statement alluded to in the foregoing, that the morbid mental excitation in melancholia as well as in mania does not augment, but impedes the general change of matter in the human system in cases connected with primary anæmia.

This latter fact has, however, no reference to the exalted mental condition combined with paresis, as the last table X shows. Although imperfect as it is, it appears to reveal the interesting fact of a morbid increase of change of matter at the cost of the constituents of the body itself.

Another point in the tables, to which I would call attention, is the high specific gravity of the urine in the majority of cases of chronic anæmia, a fact which does not quite correspond with the small amount of urea present. In some of the cases analyzed I found a very high percentage of chlorides, which may account for it, yet my observations on the amount of these, of the sulphates and of iron, are not closed. The amount of uric acid excreted has been determined in each case analyzed, but has been left out in the tables on account of its small amount on the one hand, and the great variations in its quantity on the other, without any apparent relation to the quantity of the other constituents of the urine.

The great uniformity in the amount of the phosphoric acid belonging to the earthy phosphates, is well worth noticing, although it remained, with the exception of the cases of acute mania, table VIII, and of chlorosis, table IX, much below the normal. There

was also in five cases, tables III, IV, V, VI and VIII, a marked tendency to affections of the bladder, with alkaline fermentation of the urine, which, however, readily yielded to the administration of lactic acid.

From the facts presented in the tables, we draw the following conclusions in regard to the general change of matter in anæmia, as far as its amount is indicated by the amount of urea and phosphoric acid eliminated through the kidneys :

1. In primary chronic anæmia there is a remarkable decrease in the amount of urea and phosphoric acid in the urine, which indicates grave disturbances in the nutrition of the tissues, and a diminution of the general change of matter in the system.

2. The diminution in the general change of matter reaches its lowest point in chronic anæmia with dementia, and next to this in cases connected with sub-acute mania, with a tendency to dementia.

3. The condition of morbid mental excitement in primary chronic anæmia is co-existent with a decrease in the general change of matter, and seems, to a certain degree, to impede the processes of waste and repair.

4. In cases of anæmia of a more acute character with a favorable physical and mental prognosis, there is a remarkable increase in the general change of matter during rest.

5. In the case of acute anæmia the amount of the general change of matter was not affected by the considerable loss of blood.

6. Secondary anæmia is combined with a morbid increase in the general change of matter at the cost of the tissues of the body.

7. In regard to the treatment of anæmia the conclusions drawn from the tables would indicate the great therapeutical value of rest, bodily and mental.

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